

DP-F30 SERIES RATEMETER/TOTALIZER

Operator's Manual



M1091/1289

99604

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OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of 13 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

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To avoid processing delays, also please be sure to include:

1. Returnee's name, address, and phone number.
2. Model and Serial numbers.
3. Repair instructions.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. That way our customers get the latest in technology and engineering.

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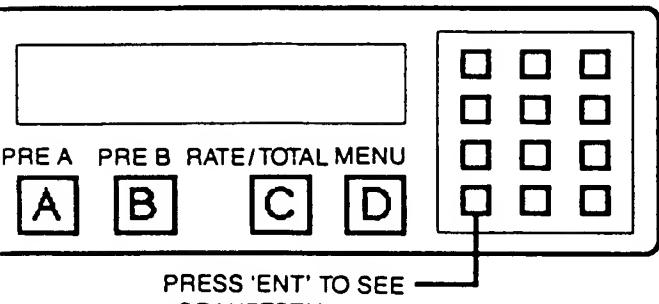
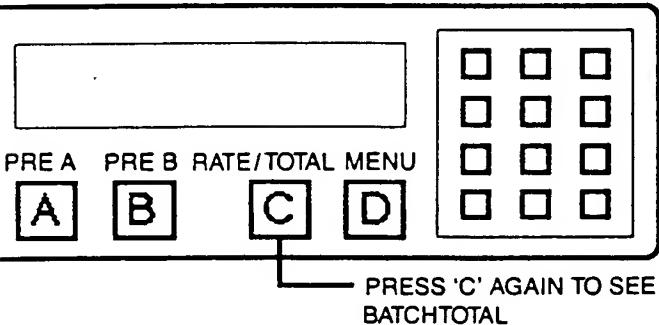
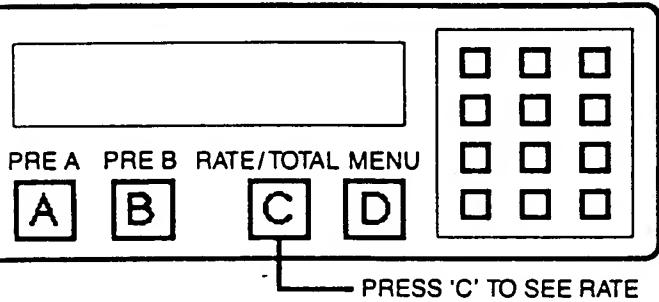
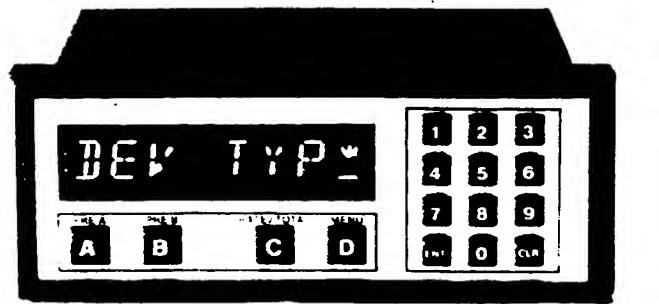
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APPLICATION

Batch control, cut to length, packaging, blending. The display may be toggled between total, rate, and grand total. Programmable K-factor makes keying - in engineering units easy. Unit accepts pulse, contact closures or analog input and provides two separate preset controls.



1 FEATURES

- * Pulse or Analog Input (with Totalizing Integration)
- * Display Total, Rate or Grand Total
- * 2 Presets - User Selectable for Total, Rate or Grand Total
- * Pulse Input to 20 KHz Count Frequency
- * 16 Point Linearization
- * K - Factor Programmable to 8 Places
- * Security Lockout
- * 2 way RS232/422/422M Communications
- * NEMA 4X Front Panel
- * Scaleable 4 - 20mA Output of Rate
- * Scaled Pulse Out, Frequency Selectable

DESCRIPTION

Featuring 8 digits of bright, .55", alphanumeric display, the pulse input version of the unit can accept up to 20,000 pulses per second. The analog input version accepts inputs, such as 4 to 20mA or 1 to 5V. It uses a highly linear integrator (V to F converter) to generate 0 to 10KHz digital pulses. The unit has two separate, 8 digit, floating decimal, "K" factors to convert the inputs to meaningful count and rate data. The user, with the push of a button, can toggle back and forth to view the total of the batch, the rate of flow and the grand total count.

Two controls outputs can be assigned independently by the user to activate at preset batch count, rate or grand total for .1 to 9.9 seconds or until reset externally.

A scaled pulse output is also provided by an open collector driver. Since the output frequency is user selectable at 10, 200, 2K or 20KHz, the unit can transmit the count data to electromechanical or electronic counters as well as computers, programmable controllers or other monitor equipment.

An optional analog 4 to 20mA output, selectable between rate or total, allows the user to select 4mA and 20mA rate settings to control strip

chart recorders or other peripherals.

Up to 15 units can be connected to optional RS232 or RS422 communications port to set control points or access data. With RS422M up to 256 units can be linked together and addressed separately to transmit unit states or accept new set points. The Baud rate is "Auto Ranging" from 300 to 19.2K. It is also OPTOMUX Compatible.

2 SPECIFICATIONS

Display

8 Digit, .55" Segment, Red Orange, LED.

Input Power

A: 110 VAC $\pm 15\%$ or 12 to 27 VDC

B: 220 VAC $\pm 15\%$ or 12 to 27 VDC

Current

Maximum 280 mA DC or 5.3 VA at rated AC voltage.

Output Power

(On AC powered units only): +12 VDC at 100mA. Separate isolated 12 VDC at 100mA to allow ± 12 VDC or +12 VDC regulated $\pm 5\%$ worst case.

Memory

EEPROM stores all program and count data for minimum of 10 years if power is lost.

Pulse Inputs

Standard, High impedance pulse input. Open or 0 to 1 VDC (low) 3 to 30 VDC (high) 10K Ohm impedance 20 KHz max. input speed (min. on/off 25 usec.).

Analog Inputs

The current loop or voltage input is converted to a highly linear 0 to 10KHz frequency. This frequency can then be scaled by the 8 digit K - Factors to count or display rate in separate engineering units.

Accuracy over full temperature range:

Zero error: $\pm 0.175\%$ full scale max.

Overall error: $\pm 0.5\%$ full scale max.

Reset

Front push button: "Clear" resets displayed number and control output.

Remote: 3 to 30 VDC positive edge resets batch counter and control output.

Impedance: 10K to ground (-DC)

Minimum pulse: 5 msec

Temperature

Operating: $+32^{\circ}\text{F}$ (0°C) to $+130^{\circ}\text{F}$ ($+54^{\circ}\text{C}$)

Storage: -40°F (-40°C) to $+200^{\circ}\text{F}$ ($+93^{\circ}\text{C}$)

Factored Output

The unit give one pulse out for each factored count. Open collector sinks 30 VDC maximum to 1 volt maximum at 100mA maximum. Output speed is user selectable (see Table below). An internal buffer holds up to 10,000 pulses for output at the selected frequency before "DATALOST" flashes, indicating pulses are lost. If factored rate exceeds 7 digits, "RFF..." flashes. These alarms indicated that speed has been exceeded.

Speed (Hz)	10	200	2000	20000
Minimum on/off(msec)	47.5	2.0	0.2	0.013

Control Outputs

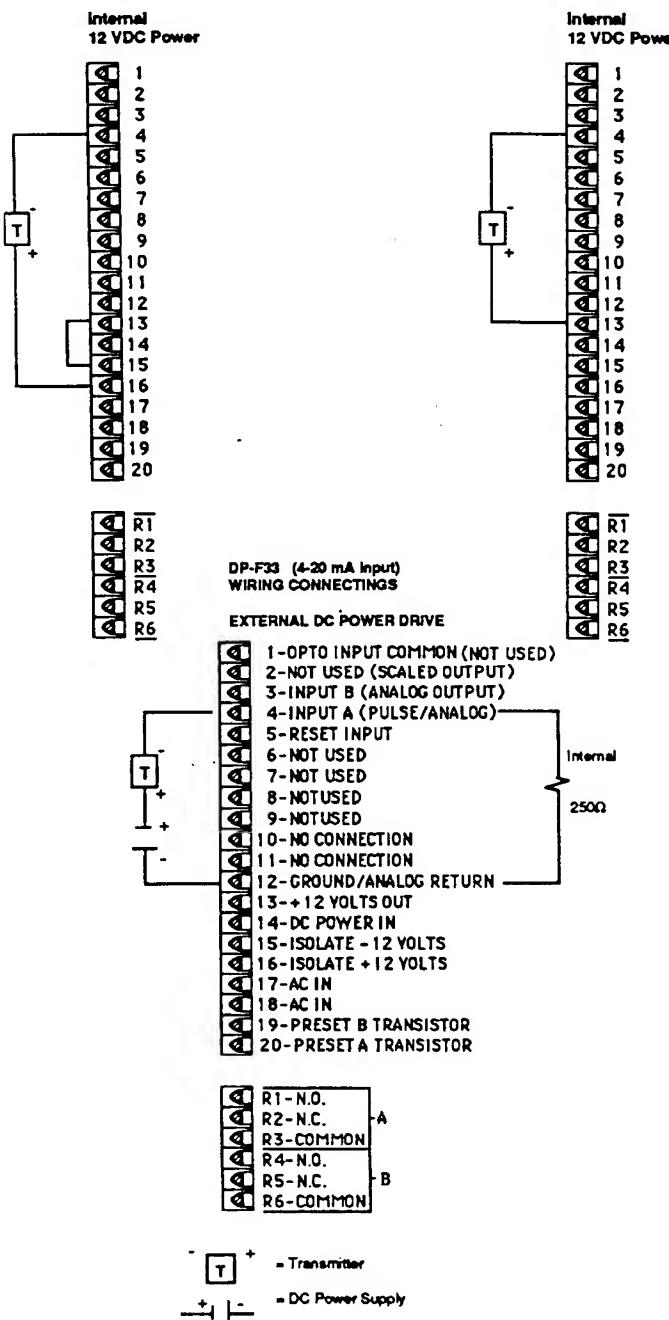
(Each of two outputs)

- 1) NPN Transistor Version: (Optional)
Open collector sinks max. 250mA from 30 VDC when active. (When relay is used, 10 VDC is provided at transistor outputs through relay coil. If greater than 2mA is used, relay will remain energized. Applying greater than 10 VDC may destroy unit. Transistor will sink 100mA in "ON" state).
- 2.) SPDT Relay Version:
10A 120/240 VAC or 28 VDC (Standard)

Analog Output

Digital or analog inputs (except square law) can be ordered with a 4mA to 20mA output of the rate or total reading. User keys in the 4mA and 20mA settings at set-up. A sinking driver generates a corresponding linear current through the external devices, updating with each update of the rate or total. Accuracy is ± 100 μ A worst case. Compliance voltage must be 3 to 24 VDC, non-inductive. (The unit can provide the DC source as long as the drop across any device being driven does not exceed 21 V).

3 TERMINATIONS



4 OPERATIONS

Presets

Two control presets are provided on the unit. The preset numbers can be made to flash without interrupting the control function by pressing "A" (Preset A) or "B" (Preset B). Press "ENT" to return to rate or total display. Change the preset by clearing the flashing preset number and keying in a new number before pressing the "ENT" button. (Count pulses may be lost if the preset is changed while pulses are coming in.) In the "Relay Set-Up" the user selects either one or both preset outputs to be activated the total, grand total, or rate. If selected for total or grand total the outputs can be set to activate the preset count for 0.1 to 9.9 seconds or latch (0.0 setting) until reset. If selected for rate control, the rate will be compared with the preset at each display update and the output activated if the rate is equal or greater than the preset. The output drops out again only if the rate drops below the preset. If the rate goes out of scale, the display will show all "F" and the output will remain in the state prior to going out of scale.

Outcard

RS232 or RS422 serial two way communication options are available. Up to 15 units can be linked together and addressed separately to transmit unit status or accept new set points in the standard ASCII format. Baud rates of 300, 600, 1200, 2400, 4800 or 9600 as well as choice of odd, even, space or mark parity can be selected by keypad control.

OPTION 1: RS232 Serial Interface

OPTION 2: RS422 Serial Interface

OPTION 5: RS422M Serial Interface (See RS422M Section)

Lockout

Unauthorized front panel changes can be prevented by entering a user selected 4-digit code, in the "LOCKOUT" mode. A (2) level "LOCKOUT" offers the user the option to "LOCKOUT" all front panel changes or "LOCKOUT" all but preset A, B, and CLR. The

status of the unit can be observed but, "LOCK ON" appears if changes are attempted. Entering the code returns the unit to "LOCK OFF" status.

RATEMETER

Accurate to 5 1/2 digits (\pm display digit). The rate meter can be programmed to accept almost any number of pulses per unit of measurement, sample from 2 to 24 seconds maximum, and autorange up to 6 digits of significant information. The rate meter with a "K" factor of 1 displays the rate of pulses per second. Simply dial in the proper "K" factor to display in minutes, hours or other units of measurement.

Press the "C" button while the units is displaying the batch to display the rate; "R" is displayed on the left side of the display.

K-FACTOR

The K-Factor is used to convert the input pulses or frequency generated internally by the analog input to engineering units. The 8 digit K-Factor dividers, with decimal keyed into any position, allow easy direct entry to any K-Factor greater than 0.0001 to 9999999.

Separate K-Factors may be entered for the count and rate section. Thus, you may batch and total in gallons and display rate in liters per hour. The maximum factored count speed is 20,000 Hz. The maximum factored rate is 7 digits.

16-POINT LINEARIZATION variable K-factor option makes flow systems more accurate and often extends their usable range by allowing users to dial in different K-factors for different flow rates. It works with either pulse input or standard analog current loop or voltage input.

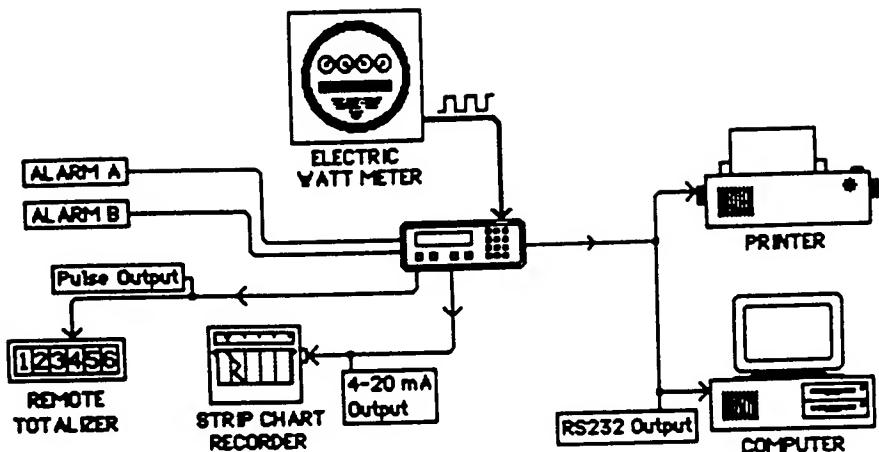
It is recommended for flow meters whose K-factors change with different rates of flow. This option can also be used to display static volume in irregular shaped vessels by interfacing level or pressure transducers to the analog input.

From 3 to 16 pints of frequency from 0 to 10,000 Hz and K-factors greater than .0001 to 999,999 are dialed in at set up. Unit uses 8-digit floating math to interpolate between settings. Rate per second, per minute or per hour programmability eliminates the need to calculate separate K-factors for total and rate.

COUNTER

Each of the total and grand total counters have 8 digits. In the set-up mode choose "RO" (reset to zero) for adding operation or "SP" (set to preset) for subtracting operation. While viewing the count, the display can be made to flash the grand total. While flashing the grand total, CLR resets the grand total counter.

APPLICATION

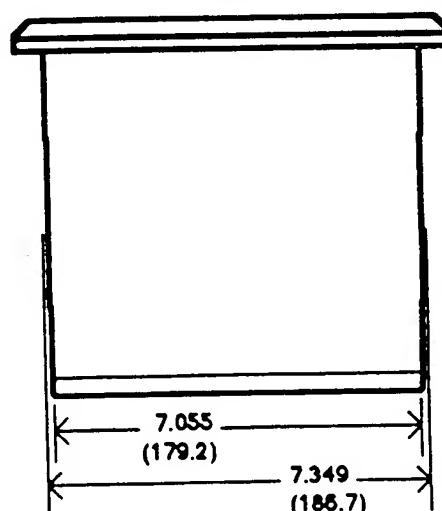
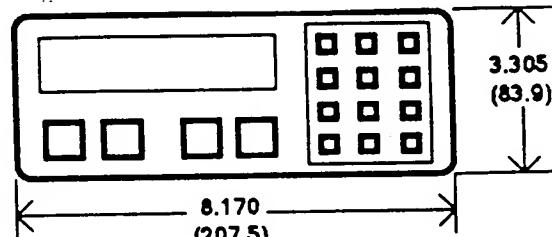
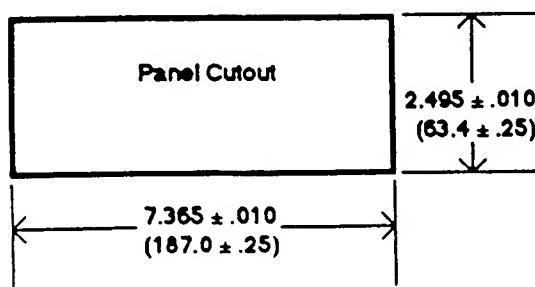
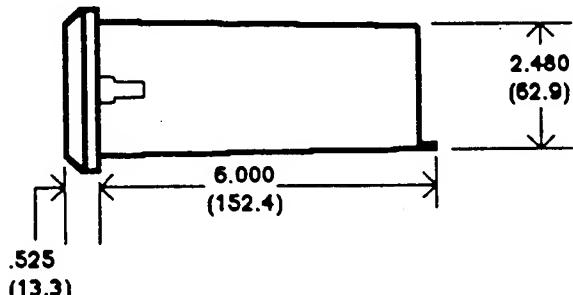


The unit monitors the power consumption and transmits the rate, total or grand total usage upon command to a printer, PLC or computer. Either control Relay A or Relay B can be activated by rate, total or grand total readings. If Relay A is set for rate, it can activate an alarm for load management if the preset usage is exceeded. Relay B can be set to activate at any rate, total or grand total alarm setting. The customer has it his way when selecting the external devices to record the unit data. A frequency selectable pulse output can drive any

totalizer, PLC, computer or other pulse input device from 10 to 20,000 Hz. With the analog output option the customer keys in both the 4mA and 20mA rate settings and the unit drives the strip chart recorder, load shedding or other monitor devices. Finally, with the RS232/RS422 or RS422M option the customer can have a printer record any data or have a computer communicate with up to 256 units to monitor the usage, change alarm points, reset the internal counters, etc. from a remote location.

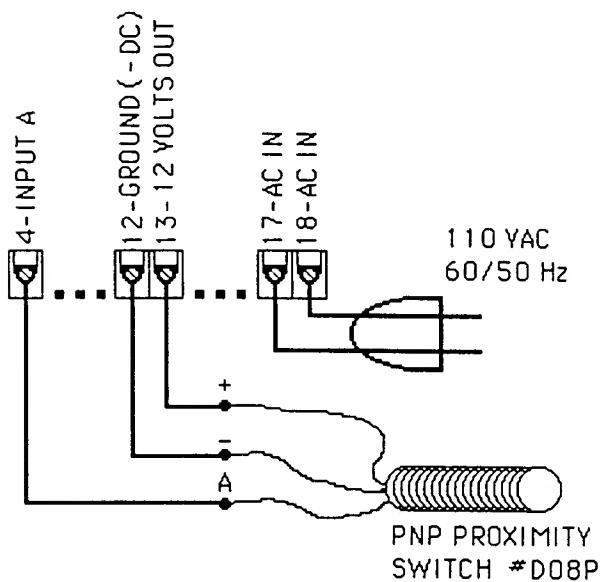
MOUNTING AND DIMENSION

Dimensions are in inches (mm)

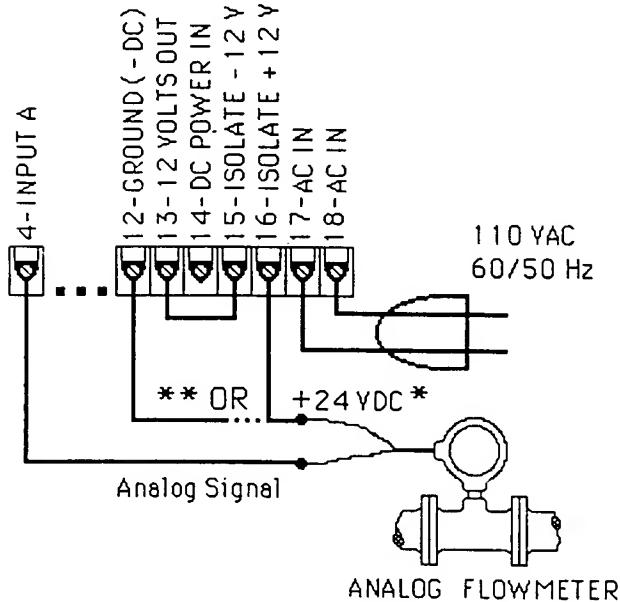


RATE/TOTAL CONTROLLER

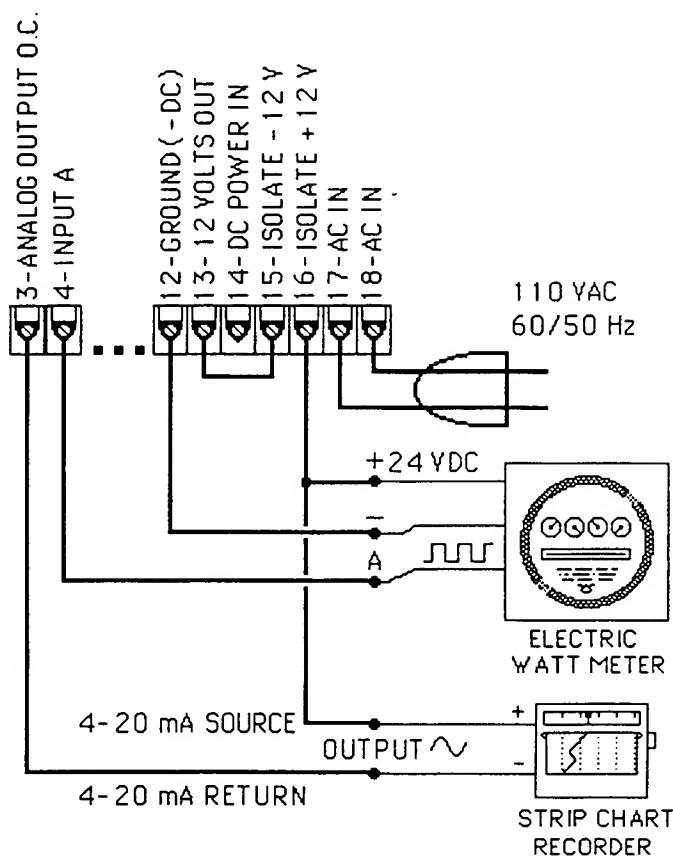
PNP PROXIMITY SWITCH



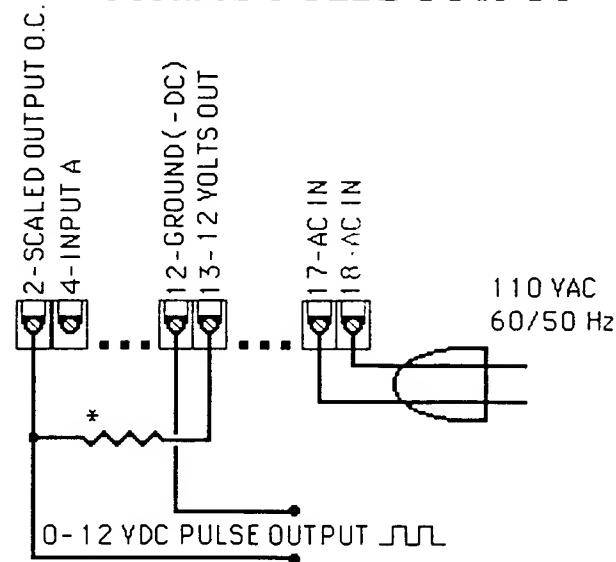
ANALOG INPUT



PULSE INPUT WITH ANALOG OUTPUT



SCALED PULSE OUTPUT



* MUST BE GREATER THAN 150 OHMS

9.0 UNIT SETUP PROCEDURE WARNING !

START HERE AND FINISH TO END: DO NOT JUMP OR SKIP! IF YOU MAKE A MISTAKE, PRESS ENT UNTIL YOU REACH THE BEGINNING.

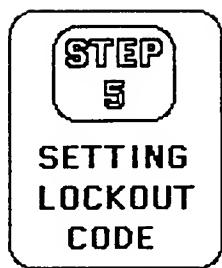
PRESS	DISPLAY
STEP 1 SETTING PRESET A	A (FINAL PRESET) PRESET A . . . THEN FLASHING PRESET #
CLR	0 FLASHES
1 2 3 4 (SAMPLE PRESET)	1 2 3 4 PRESET FLASHES
ENT	1 2 3 4 IS ENTERED
STEP 2 SETTING PRESET B	B (PREWARN) PRESET B . . . THEN FLASHING PRESET #
CLR	0 FLASHES
1 2 0 0 (SAMPLE PREWARN)	1 2 0 0 FLASHES
ENT	1 2 0 0 IS ENTERED
STEP 3 SETTING THE COUNTER	D MENU FLASHES.. TO DEV TYP↓ ENT RT↓ CNT↓ (RATE OR COUNT) D (SET UP COUNTER) K FACTOR FLASHES; THEN SHOWS CURRENT K FACTOR (E.G. 1000) CLR 0 FLASHES 1 D 2 7 8 1 . 2 7 8 FLASHES (PRESS D FOR DECIMAL POINT) K FACTOR IS DIVIDER. IT CONVERTS INPUT TO ENGINEERING UNITS. ENT (K FACTOR ENTERED) RO↓ SP↓ (RESET TO 0 "ADD" OR SET TO PRESET "SUBTRACT") B OR D SELECTS RO OR SP ENT (SELECTION ENTERED) DEC LOC (DECIMAL POINT LOCATION) PRESS ANY NUMBER DEC. PT. MOVES TO THAT POSITION ENT LAST COUNT READING

COUNTER IS SET!

**STEP
4**
**SETTING
THE
RATEMETER**

<u>PRESS</u>	<u>DISPLAY</u>
D	MENU FLASHES... TO DEV TYP↓
ENT	RT↓ CNT↓ (RATE OR COUNT)
B (RATEMETER SELECTED)	K FACTOR FLASHES; THEN SHOWS CURRENT K FACTOR (E.G. 1000)
CLR	0 FLASHES
2 7 D 8	27.8 FLASHES
(PRESS D FOR DECIMAL POINT)	
K FACTOR IS DIVIDER. IT CONVERTS INPUT TO ENGINEERING UNITS.	
ENT (K FACTOR ENTERED)	WINDOW ##
CLR	WINDOW 00
5 (AS AN EXAMPLE)	WINDOW 05
(EXTENDS THE SAMPLING WINDOW TO 5 SECONDS)	
ENT (WINDOW ENTERED)	SIG FIG ##
CLR	SIG FIG 00
6 (AS AN EXAMPLE)	SIG FIG 06
(SIG FIG INDICATES HOW MANY MEANINGFUL DIGITS ARE SHOWN -- TRAILING ZEROES ARE INSERTED IF NECESSARY)	
ENT (SIG FIG ENTERED)	WEIGHT ##
CLR	WEIGHT 00
6 6 (AS AN EXAMPLE)	WEIGHT 66
(WEIGHT IS A WEIGHTED AVERAGING FACTOR; HIGHER SETTINGS PROVIDE MORE AVERAGING FOR A MORE STABLE DISPLAY)	
DERIVED FROM THE EQUATION: <u>(OLD DATA x "WEIGHT" + NEW DATA) / ("WEIGHT" + 1)</u>	
NOTE: PRESSING THE "CLR" BUTTON WHILE VIEWING THE RATE WILL UPDATE THE RATE DISPLAY TO THE LAST SAMPLE	
ENT (WEIGHT ENTERED)	(LAST COUNT OR RATE READING)

YOUR RATEMETER IS SET!



D	MENU FLASHES... TO DEV TYP↓
D	LOCKOUT↓
ENT (LOCKOUT SELECTED)	CODE FLASHES; THEN SHOWS OLD CODE NUMBER.
CLR	0 FLASHES
1 1 1 1	1 1 1 1 FLASHES
ENT (CODE ENTERED)	PR LCK↓ PR UNLK↓ (Lockout of front panel) (Lockout of all front buttons except Presets A, B and CLR)
ENT (LOCKOUT SELECTION ENTERED)	LAST TOTAL COUNT READING
1 1 1 1	LOCK ON FLASHES (APPROPRIATE PANEL CHANGES LOCKED OUT)
1 1 1 1	LOCK OFF FLASHES (PANEL CHANGES ALLOWED)

LOCKOUT IS SET UP!

**STEP
6**
**SETTING
THE
OUTPUT
COMM.
CARD**

**SKIP IF
NOT USED**

<u>PRESS</u>	<u>DISPLAY</u>
D	MENU FLASHES... TO DEV TYP\downarrow
D	LOCKOUT\downarrow
D	OUTCARD\downarrow
ENT (OUTCARD SELECTED)	UNIT ##
CLR	UNIT 00
1 2 (AS AN EXAMPLE)	UNIT 12
ENT (UNIT LABELED 12)	PL\downarrow SER\downarrow (RS422M)*
ENT	BAUDRATE FLASHES THEN DISPLAYS LAST BAUDRATE USED.
D	300\downarrow
D	600\downarrow
D	1200\downarrow
D	2400\downarrow
D	4800\downarrow
D	9600\downarrow (PRESS D TO GO TO 300\downarrow)
ENT (PRESS AS DESIRED)	PARITY FLASHES, THEN LAST PARITY SELECTED IS DISPLAYED.
D	EVEN\downarrow
D	ODD\downarrow
D	MARK\downarrow
D	SPACE\downarrow (PRESS D TO GO TO EVEN\downarrow)
ENT (PRESS AS DESIRED)	LAST COUNT READING

**SERIAL COMMUNICATIONS
PORT IS SET UP!**

* Use **PL \downarrow** for RS422M Serial Communications.
When entered, unit goes to LAST COUNT READING.

**STEP
7**

**SETTING
RATE OR
TOTAL
FOR 4 mA
AND 20 mA
ANALOG
OUTPUT**

**SKIP IF
NOT USED**

<u>PRESS</u>	<u>DISPLAY</u>
D	MENU FLASHES... TO DEV TYP↓
D	LOCKOUT↓
D	OUTCARD↓
D	ALG OUT↓ (PRESS D TO GO TO DEV TYP↓)
ENT (ANALOG SETUP SELECTED)	ANLG RT↓ (SELECT 4-20 mA OUTPUT OF RATE)
D (PRESS D TO TOGGLE BETWEEN SELECTIONS)	ANLG CT↓ (SELECT 4-20 mA OUTPUT OF COUNT)
ENT (RATE OR COUNT OUTPUT SELECTED)	SET LOW FLASHES; THEN SHOWS CURRENT LOW SETTING
CLR	0 FLASHES
1 2 5 D 5 (PRESS D FOR DECIMAL POINT)	1 2 5 . 5 FLASHES
AS AN EXAMPLE. (IN THIS CASE 125.5 = 4 mA)	
ENT (LOW SET AT 125.5 = 4 mA)	SET HIGH FLASHES; THEN SHOWS CURRENT HIGH SETTING
CLR	0 FLASHES
1 5 0 D 7 (PRESS D FOR DECIMAL POINT)	1 5 0 . 7 FLASHES
AS AN EXAMPLE. (IN THIS CASE 150.7 = 20 mA)	
ENT (HIGH SET AT 150.7 = 20 mA)	LAST COUNT READING

THE ANALOG OUTPUT IS SET!

STEP 8
SETTING
OUTPUT
PULSE
FREQUENCY

<u>PRESS</u>	<u>DISPLAY</u>
D	MENU FLASHES... TO DEV TYP↓
D	LOCKOUT↓
D	OUTCARD↓
D	ALG OUT↓
D	OUT FREQ↓ (PRESS D TO GO TO DEV TYP↓)
ENT (OUT FREQUENCY SELECTED)	2000↓ (DISPLAYS LAST SELECTION)
D	200↓
D	10↓
D	20000↓ (PRESS D TO GO TO 2000)
ENT (PRESS AS DESIRED)	LAST COUNT READING

THE PULSE OUTPUT FREQUENCY IS SET!

STEP 9
SETTING
RELAY
FUNCTION
AND
ON TIMES

<u>PRESS</u>	<u>DISPLAY</u>
D	MENU FLASHES... TO DEV TYP↓
D	LOCKOUT↓
D	OUTCARD↓
D	ALG OUT↓
D	OUT FREQ↓
D	RELAY↓ (PRESS D TO GO TO DEV TYP↓)
ENT (RELAY SELECTED)	A GR TOT↓ (GRAND TOTAL SET TO CONTROL RELAY A)
D	A RATE↓ (IF RATE IS SELECTED, DURATION DISABLED)
D	A TOTAL↓
ENT (PRESS AS DESIRED)	DUR A ##

CONTINUED ON NEXT PAGE

**STEP
9****SETTING
RELAY
FUNCTION
AND
ON TIMES**

CONTINUED

<u>PRESS</u>	<u>DISPLAY</u>
CLR	DUR A 00
1 2 (AS AN EXAMPLE)	DUR A 1.2 (RELAY ON FOR 1.2 SECS)
ENT (ON TIME ENTERED)	B RATE ↓ (IF RATE IS SELECTED, DURATION DISABLED)
D	B TOTAL ↓
D	B GR TOT ↓ (GRAND TOTAL SET TO CONTROL RELAY B)
ENT (PRESS AS DESIRED)	DUR B #*
CLR	DUR B 00
5 5 (AS AN EXAMPLE)	DUR B 5.5 (RELAY ON FOR 5.5 SECS)
ENT (ON TIME ENTERED)	LAST COUNT READING

RELAY ON TIMES SET!

NOTE: AT THIS POINT YOU SHOULD BE
ALL SET UP AND READY TO GO!

**VIEWING
RATE,
BATCH
TOTAL,
GRAND
TOTAL**

C	R ##### (RATE READING)
C	##### (BATCH TOTAL) PRESS C TO GO BACK TO RATE AGAIN
ENT	GR TOTAL FLASHES THEN THE GRAND TOTAL FLASHES
ENT	##### (BATCH TOTAL) PRESS C TO GO BACK TO RATE AGAIN PRESS ENT TO GO BACK TO GR TOTAL

10 PULSE INPUTS

Accept output pulses from most encoders, prox. switches or connectors. Connect the pulse to Input A Pin 4.

The unit counts on the negative edge of a pulse:
Low: 0 to 1 VDC, High: 3 to 30 VDC.

10.1 INPUT

Has a 10K Ohm pull down resistor to ground and must be driven high by a sourcing device such as a PNP transistor or a contact to DC, Pin 12.

10.2 INPUT Has a 4.7K Ohm resistor to +12 VDC and must be driven low by a sinking device such as a NPN transistor or a contact to ground (Pin 12).

10.3 PULSE SPEED

The Max input speed is specified by the 8th digit of the part number based on a 50% on/off pulse. Although the unit can accept pulses as short as 25 usec on/off if speed "E" is selected, it is advised that only the maximum speed needed be ordered. When lower speeds are specified (8th digit of part number), additional filtering is added that make the inputs more immune to electrical noise. "A" input speed should always be used when pulsing with a switch contact to prevent additional erratic count inputs. (See "DATALOST" not in Section 13.)

10.4 INPUT SWITCH SELECTION

Inputs use an input signal conditioning board which is plugged onto the main board just behind the display. It has dip switches which set the debounce filtering (max. count speed). (See section for "Removing Case" to get to the input modules if changes on the pulse input board are needed.)

S1, S2 determine debounce filtering and control max. input speed,
(A) S1, S2-ON, 0-40 Hz (min. 12.5 msec on/off)
(C) S1-ON, S2-OFF, 0400 Hz (min. 1.25 msec on/off)
(E) S1, S2-OFF, 0-20K Hz (min. 25 usec on/off)

S3, S4 set the input characteristics as designated by the 5th and 6th digits of the part number.

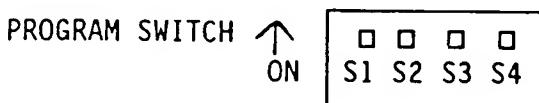
Input 3A: S3, S4-OFF (needs sourcing input)
Input 3B has S3-OFF, S4-ON (needs sinking input)

11 ANALOG INPUTS The analog input versions accept signals from transmitters that give linear outputs. The input signal modules are mounted just behind the display and are calibrated for the input specified. Insure that the sensor output matches the unit input. Connect the analog signal to input A (Pin 4) with the return to ground (Pin 12).

6A: Square Law: 4-20mA; 250 input impedance, the 6A input is a special input that compensates for non-linear inputs. Specifically, inputs that require square root extraction to provide accurate count and rate determinations. The input signal is converted to 0 to 10,000 pulse per second input to the process (see Table below).

4-20mA Square Law Table

mA Input	Pulse/Sec	mA Input	Pulse/Sec
4	0000	10	6123
5	2500	12	7071
6	3535	16	8660
7	4330	18	9354
8	5000	20	10000



To calculate the Pulse/Sec for a particular input use the following formula:

$$\sqrt{\frac{mA - 4}{16} \times 10000} = \# \text{ Pulse/Sec to Processor}$$

EXAMPLE: To calculate the Pulses/Sec for 9mA Input.

$$\sqrt{\frac{9 - 4}{16} \times 10000} = 5590 \text{ Pulses/Sec to Processor}$$

If a different unit of measure is desired, factor the given transmitter rating to the desired unit of measure in units per second and use the formula above. Eg. 5V rating of transmitter is 250 gal. per hr. and it is desired to totalize in liters. Rate in liters per second is $.2628701$ (250×3.78533 [gal. to liters] divided by 3600 [hr. to sec]). Counter K-Factor to key into unit to totalize in liters from 250 gal. per hr. transmitter is: 38041.603 (10000 divided by $.2628701$).

11.1 SETTING K- FACTOR FOR ANALOG INPUT

The analog inputs are converted to a highly linear 0 to 10000 pulse per second frequency. The high level of any analog input will generate this 10000 Hz frequency. The pulses go directly to the central processor. Use the counter and ratemeter K- Factors to convert the pulses to the correct units of measurement.

Rate K- Factor: $10000/R$, where R = high output rating (20mA or 5V) of transmitter. 10000 divided by $20mA$ or $5V$ rating of transmitter. Eg. 20mA rating of transmitter is 250 gal. per min. Use input 5A (4 - 20mA). The rate K - Factor to key into the unit for gal. per min. is 40 (10000 divided by 250).

If a rate is desired in a different unit of measure or a different timebase, factor the transmitter rating to the unit of measure and timebase desired and use the formula above. Eg. 5V output rating of a transmitter is 300 gal. per min. and rate desired is liters per hr. Use input 5C (1 to 5V), The factored rate for this transmitter for liters per hr. is 68135.94 (300×3.78533 [gal. to liters] $\times 60$ [min. to hr.]). The rate K - Factor for liters per hr. is 0.1467654 (10000 divided by 68135.94).

Counter K-Factor: $= 10,000/R/Sec$, where R = High output rating (20mA or 5V) of transmitter factored to rate per second. Eg. 20mA rating of transmitter is 500 gal. per min. Rate per sec. is 8.3333333 (500 divided by 60). Counter K-Factor to key into unit is 1200 (10000 divided by 8.3333333).

11.2 ANALOG INPUT EXCHANGE/CALIBRATION

If an analog sensor cannot be obtained that matches the unit input, it is recommended that the unit be returned to have the analog input module exchanged and recalibrated. Recalibration should only be attempted by someone who had the equipment to generate a very accurate low and high signal and who has the training to open the unit and work with grounded equipment necessary to protect the static sensitive CMOS circuitry.

Set the ratemeter at 6 sig. fig., the window at 01 and the K - Factor at 1. See the section "Removing the Case" to get the analog input card, mounted just behind the display, there are two pots that set the "0" (R3) and 10000 Hz (R15) frequency. R3 and R15 are silkscreened just under the .3 inch square pots. While inputting a very accurate high input signal. Set R15 so that the frequency is 9999 to 10000. Go back and readjust R3 to insure it is at "0". Readjust R15 until it is as close as possible to 10000.

12 RESET

The reset is edge active; once reset, the unit will accept new data even if reset is held.

12.1 FRONT PUSH BUTTON RESET

Pressing the front CLR button will reset the control output and any displayed number (load the "Preset A" number into the display if "SP", subtracting mode of operation, has been selected).

12.2 REMOTE RESET

Applying a 3 to 30 VDC pulse of minimum 5 msec resets the batch counter and control output. Impedance 10K to ground (-DC).

12.3 AUTO RESET

To recycle the unit, choose the preset which is to activate the reset and set it's "Relay Duration" as short as possible. Place a 10K Ohm resistor between reset (Pin 5) and the chosen transistor output for the preset chosen (Pin 19 or Pin 20). The relay acts as a pull up resistor and the unit resets after the control output "times out". After the unit is reset it will operate even though the reset is high. The reset is edge triggered and only resets when the input goes high. Note that if Pin 5 is pulled high by a resistor, it must be pulled low a min. of 5 msec and then allowed to go high to reset the unit.

13 K - FACTOR/"DATALOST"/"RFFF..."

The K- Factor is used to convert the input pulses or frequency generated internally by the analog input to engineering units.

The 8 digit K -Factor dividers, with decimals keyed into any position by use of the "D" button, allows easy direct entry of the desired K - Factor. A separate K - Factor may be entered for the count and rate section. Thus you may batch and total in gallons and display rate in liters per hour.

NOTE: If the counter K - Factor is .0001 or less or if the factored count speed exceeds 20000 CPS, "DATALOST" flashes. If the input divided by the rate K - Factor exceeds 7 digits "RFFF..." flashes. These alarms indicate that the factored speed has been exceeded and data is invalid. Increase the K - Factor divider.

14 COUNTER

Unit accumulates up to 8 digits of batch and grand total count. In the setup mode choose "RO" (Reset to Zero) for adding operation or "SP" (Set to Preset) for subtracting operation. While running display can be made to display and 8 digit grand total by pressing "ENT" while

the unit is running. Activating "CLR" while the grand total is flashing, resets the grand total counter.

15 PRESETS

The unit has two independent presets. In the setup mode the user selects whether the Counter, Rate Meter or Grand Total counter activates either or both Preset A and Preset B outputs. The preset numbers can be displayed or updated at any time by pressing "A" (Preset A) or "B" (Preset B). Enter the flashing preset number or press "CLR" and key in a new number and "ENT" to enter it.

If the Total or Grand Total counter is set to control an output, that output will activate for the time duration selected under "RELAY" when the counter reaches the selected preset number.

If the Rate is set to control and output, that output will be activated when the rate equals or exceeds the preset rate and drop out again when the rate goes below the preset rate. Note that the preset for rate can be entered with decimal when keying in the rate preset number.

16 RELAY - OUTPUT TIMING

Control output timing is selected by pressing D until the RELAY mode is selected and entered. Any time duration from .1 to 9.9 seconds or latch until reset (0.0 setting) may be entered for the A and B outputs. Once the output has been activated, the unit must be reset before another output will occur.

17 SCALED OUTPUT/DATA LOST

The unit generates a pulse out for each factored count. An NPN transistor output (Pin 2), capable of driving 100mA from 30 VDC max., can drive external devices at rates of 10, 200, 2,000 or 20,000 counts per second as selected through keypad menu. (Min. on/off times in milliseconds are 47.5, 2.0, 0.2 and 0.013 respectively). If the inputs scaled by the K - Factor generate faster pulses than the output speed selected, an internal buffer will store up to 9,999 counts

before "DATALOST" flashes on the screen. This indicates that the counts being totaled and the scaled outputs may be incorrect. Note that all counts being totaled and the scaled outputs may be incorrect. Note that all counts stored in the internal buffer will be pulsed out at the selected frequency even if the counter is reset.

Speed (Hz)	10	200	2000	20000
Minimum on/off (msec)	47.5	2.0	0.2	0.013

18 RATE METER

Accurate to 5 1/2 digits (\pm one display digit); the ratemeter is autoranging and can be programmed by the K - Factor to display almost any engineering unit of measurement. To display the rate press the "C" (RATE/TOTAL) button while the unit is displaying the batch. "R" is displayed on the left side of the display to indicate that rate is being displayed.

The unit calculates the rate from the period between pulses. The unit measures the average time between pulses, divides this by the K - Factor and a reciprocal math calculation to find the rate per second. As long as pulses come in faster than 3 per second the unit will update each second. The 2 to 24 second "WINDOW" time, selected at set up, is the maximum time the unit will wait for sufficient pulses to make an accurate calculation before it displays zero.

1 to 6 "SIG FIG" (significant figures) can be selected in the set up mode. The unit will normally display the number of digits selected. The unit will normally display the number of digits selected. The unit is auto ranging and will place the decimal within these digits to display the true factored rate. If the rate, scaled by the K - Factor, has more digits to the left of the decimal point than the number of significant digits selected, additional zeros will be added to fill in digit spaces to the left of the decimal place. Eg. Factored rate is 123.456. A: "SIG FIG" set 4, display reads 123.4 B. "SIG FIG" set 2, display reads 120. This allows the user to show either

the exact rate with the least significant digits changing with only a slight rate change or to create a more stable display by showing zeros in the less significant digits.

NOTE: If the rate exceeds 7 digits, the display shows "RFF..." indicating speed has been exceeded.

18.1 SETTING RATE K - FACTOR FOR PULSE INPUT

K - Factor (rate per sec.) = pulses per unit (gallon, foot, revolution)

K - Factor (rate per min.) = pulses per unit 60

K - Factor (rate per hr.) = pulses per unit 3600

The rate meter with a K - Factor of 0 to 1 displays the rate of incoming pulses per second. To display the frequency or rate per second simply key in the number of pulses per gallon, revolution, foot or other unit of measurement. This will usually be the same as the K - Factor used for the count. If it is desirable to display the rate per minute, or hour, divide the pulses per unit of measurement stated on the sensor by 60 (rate per minute) or 3600 (rate per hour). Example: A sensor generates 850 pulses per gallon and you want to display gallons per hour. Set the counter K - Factor at 850 to batch in gallons. Set the rate K - Factor at 0.2361111 (850 divided by 3,600). To convert to other units of measurement calculate the number of pulses for the desired unit of measure and use the formula above.

Example: Sensor give 850 pulses per gallon and you want to batch in liters and display in liters per minute. (Example uses conversion 1 gallon equals 3.78533 liters). Counter K-Factor = 224.55109 (Sensor gives 224.55109 pulses per liter - 850 divided by 3.78533). To find the rate per minute K - Factor divide the count K - Factor for liter (224.55109) by 60 (seconds per minute) = 33.743518.

19 2 - STAGE LOCKOUT

Unauthorized front panel changes can be prevented by entering a four digit code chosen by the user in the LOCKOUT setup mode. The unit leaves the factory with code 1,000. (If a code of less than 4 digits has been entered, the unit adds prefix "0's" to make a four digit code.) The selected code should be recorded in a safe place. A choice of two level lockout offers the user the option to lockout all front panel changes or lock out all but presets A, B and CLR. Entering the code in the set up mode does not disable the keypad, but keying in the four digit code while in the run mode will activate "LOCK ON". The status of the presets, rate and grand total can be viewed but "LOCK ON" appears if changes are attempted. Only by keying in the four digit code into the keypad while the unit is in the run mode will the unit return to the "LOCK OFF" status.

20 REMOVING THE CASE

To install or change the input or data interface cards, the case must be removed. Before opening case, remove all power. CMOS logic is used. Use standard precautions against damage by static discharge. If the unit has a data interface option (RS232/422/422M), two screws in the back, designed to secure the top left connector, may have to be removed. Next remove the six (6) flat head 4-40 x 1/4" screws behind the panel and lift off the panel/lens assembly. Slide the main board display out the front of the case. Once modifications are made, reverse the procedure to re-assemble the unit, insuring that the main board is in the track. The six (6) screws that hold the panel must be tight to seal the rubber keypad panel assembly, approximately 0.6 in" lb. torque.

21 INPUT CARD MODIFICATION

Follow "Removing the Case" procedure (Section 20). The Input Card is mounted just behind the display and plugs onto the 15 pin post connector. Remove the board and make desired changes. When installing the input card, insure that the component side of the board is facing the front and that the 15 pin connector is mated

to the proper pins and not offset to the side. Replace the front panel per section 20.

22 INTERFACE INSTALLATION - RS232/RS422/RS422M

Follow "Removing the Case" procedure (Section 20). The RS232 and RS422 cards have a 15 contact ribbon cable that plugs into the female connector next to the heat sink. Choose the proper interface card. With components on top and subminiature connector to the back, plug in the harness and mount the card on the four (4) standoffs provided. After the main board is inserted into the case, replace the front panel per Section 20.

23 OUTCARD RS232/RS422/RS422M SERIAL/STROBE INTERFACE

If the serial interface option is supplied, up to 15 units can be linked together. (See "Strobe Input Operation" t link more than 15 units). Units status and new set points can be communicated by remote hook-up. Mode changes, however, must always be made on the front keypad. Data is transmitted at selected baud rates using standard seven bit ASCII characters and parity with two additional bits of "Start" and "Stop" to make up the standard ten bit character. (See Unit setup to select and enter desired Code Number, Baud Rate and Parity). RS422M has automatic baud rate selection and uses an eight bit word, up to 256 units can be linked together. (See RS422M Section)

23.1 UNIT CODE

Each Unit in the hook-up must be assigned a code number from 1 to 15 through the front keypad in the "Outcard" set up mode. Number "00" is reserved for a dedicated hook-up to only one terminal and its transmit output line remains in an "on" active state. (Units assigned other numbers have outputs that remain in the "off" high impedance state until addressed by their code number or brought on line by positive edge of Strobe input). Once a unit is addressed, do not address another unit until the data has been entered, a "Carriage Return" has been sent and

any data requested has been transmitted back.

23.2 BAUD RATE

The baud rate is the speed at which data is transmitted, expressed in bits per second. Baud rates of 300, 600, 1200, 2400, 4800 or 9600 are available. Use the front keyboard to call up the "Outcard" set up mode and select the desired baud rate that is compatible with the remote terminal.

23.3 PARITY

Parity is a bit of information that is inserted before the stop bit is used. It is used to help check that the transmission is correct. In the "Outcard" set up mode, select between "Odd" (Parity bit is logical zero if total number of logical 1's in the first seven data bits is odd), "Even" (Parity bit is logical zero if total number of logical 1's in the seven data bits is even), "Mark" (Parity data bit always logical 1 - high/Mark), "Space" (Parity data bit always logical 0 - low/Space). If a "Mark" parity is chosen, it will appear that two (2) stop bits are used. Use the "Mark" parity with terminals using parity "OFF" or "NONE". These terminal ignore the parity. The unit does not check the parity but does transmit the parity chosen. If the parity requirements of the interface terminal are not known, it is often practical to key in a different parity until the correct one works.

23.4 RS232 ELECTRICAL REQUIREMENTS

Unit uses standard E1A specifications. Standard inputs must present a load of 3000 to 7000 Ohms. A voltage level of +3V to +25V (referenced to signal ground) is read as a "Space" or "0" and indicates an active state (asserts a control line). A voltage level of -3 to -25V is read as a "Mark" or "1" and does not indicate an active state (does not assert a control line). Outputs must send a voltage of +5 to +25V (referenced to signal ground) for a "Space" and a voltage of -5 to -25V for a "Mark" when loaded with a 3000 Ohm load to signal ground. Outputs must be capable of being

shorted to other signal lines without burning out. It is normally recommended that cable length be limited to 50 feet.

23.5 RS422/RS422M ELECTRICAL REQUIREMENTS

The input of the unit follows the standard E1A high impedance minimum of 12K Ohms. When the 422 + (A) input is more positive than the 422 - (B) input by .2V to 6V, a "1" or "Mark" condition is recognized. When the 422+ input .2V to 6V, a "0" or "Space" is recognized. Data is recognized by the popularity of the voltage difference between the two lines. Noise picked up on the line will make little difference since the noise is usually added to each line, and the voltage differential remains the same. The output driver drives the transmit lines to a differential of 2 to 6V. It is designed to handle loads up to 60mA of sink or source current and features positive and negative current limiting for protection from line fault conditions. Since the RS422 is more immune to noise, cable links up to 1000 feet or more can be used. Because of the high input impedance of RS422, line terminating loads are recommended. For hook up to a single unit a 150 to 200 Ohm resistor across Receive Data + or - at the unit and at the remote terminal is often sufficient. For multiple hook-up, other standard terminations should be used. Total loading should not be greater than 90 Ohms.

23.6 RS232/RS422/RS422M SERIAL INPUT CODES

DXX(S) (Device and address number followed by space) activates the unit that has been assigned that number. That unit comes on line and transmits "Device XX:". Unit is now ready to receive a code or string of codes separated by a space. A "Carriage Return" (Enter) code enters the codes and processing of requests begins.

23.7 CODES FOR UNIT

DC	Will transmit count.
DR	Will transmit rate.
DT	Will transmit grand total.
KC	Will transmit counter K-Factor.
KC(S)XXX	Will load counter K-Factor number.
KR	Will transmit rate K-Factor.
KR(S)XXX	Will load rate K-Factor number.
PA	Will transmit Preset A.
PA(S)XXX	Will load preset A number.
PB	Will transmit Preset B.
PB(S)XXX	Will load Preset B number.
RC	Will reset counter to zero if in "RO" mode (adding) or set counter to Preset A if in "SP" mode (subtracting). Output is reset.
RC(S)XXX	Will set counter to number (no other change is made).
RT	Will reset grand total to zero.
RT(S)XXX	Will reset grand total to number.

To address unit, transmit a "D" (device) followed by the 1 to 15 code number and a "Space". Once the "Space" has been received, the unit becomes active and responds back, "Device XX:" (Device number). (Once active, the unit works in a full duplex, echo back mode, so that data sent from the terminal will be transmitted back for verification). Once the unit is "on line", use the proper serial transmit codes to request data or set a new value. (See RS232/RS422 Serial Input Codes). Up to 80 characters of data may be linked together and transmitted to the unit in a string as long as there is a space between the different codes. If an error is made, a correction can be made back by spacing and retyping correct data before the "Carriage Return" (Enter) is sent, the unit starts processing the data and will transmit the requested data on a non-priority basis over the data transmit line. A unit keypad entry or incoming data will halt the data communication cycle. Therefore, there should be a pause after data is requested to insure that all data has been transmitted before another unit is addressed and brought on line. (If the unit is not busy, it should not require more than 5 msec to process each request. To find the cycle time to process and transmit a request, calculate the bit transmit time by dividing 1 by the baud rate; multiply by the number of requests made. Example: Typical time to transmit 1 uninterrupted request at 300 baud rate is .272 sec. $(1/300) \times (80) + .005$.

23.8 SERIAL INTERFACE OPERATION

Data is received and transmitted over standard EIA RS232 or RS422 levels. Each 10 bit character is made up of a start bit, 7 bit ASCII code, parity bit and stop bit. Unit number, baud rate and parity are entered in the "Outcard" set up mode and remain in memory even if power is off.

Note that the input impedance of RS232 is 3K or 7K Ohm worst case. The terminal addressing the unit must be capable of driving all loads in the loop. RS422 input impedance is much higher and there is usually no problem driving 15 units. Unit serial transmit line remains in a high impedance "OFF" state until addressed. Insure that only the unit is addressed at a time.

This time will be extended if the unit must service the front keypad or one of the inputs. In practice if transmission has not started within 2 seconds after data is requested, it can be assumed that there is a problem).

When transmitting, the unit will precede each data value with a "Carriage Return" and "Line Feed" code and answer only with requested data in the order the requests were made. After all requested data has been transmitted any new communication must be started again by DXX (Device number) and space.

Following are two examples of requests and responses.

Transmit from Terminal Receive from Unit

(S) = Space

Example A:

D13(S)	Device #13
[Unit #13 Activated]	
PA(S)76546(S)PA(S)	PA 76546 PA
KC(S)1575(S)KC(S)	KC 1575 KC
RC(ENTER)	RC
[Unit presets and counter K-Factor are set, counter is reset]	
	76546
	1575

Example B:

D7(S)	Device #7
[Unit #7 Activated]	
PA(S)12347(S)PA(S)	PA12347 PA
RC(S)456789(S)DC(S)	RC 456789 DC
RT(S)376(S)DT(ENTER)	RT 376 DT
[Unit preset, counter and total count are set]	
	12347
	456789
	376

23.9 STROBE ADDRESS OPERATION

Another method of reading the status of a unit with either a RS232 or RS422 option is by means of a separate strobe address and a 3 bit data request code. Use of the strobe address method does not allow the input of new set points but theoretically hundreds of units could be linked together to transmit the data in the unit over the serial transmit line in the standard RS232 or RS422 format. The unit could be assigned any code number other than "00".

The 3 bit data request code would be latched in at the positive edge of a 3 to 30 VDC strobe input that remain high a minimum of 25 milliseconds. Requests are processed on a nonpriority basis. Normally data will begin to be

transmitted from the unit over the RS232 or RS422 serial transmit line within 5 msc unless interrupted by a keypad entry or other signal input.

No other unit should be brought on line until data requested has been transmitted.

23.10 STROBE INPUT ELECTRICAL REQUIREMENTS

Both the RS232 and RS422 interface option cards have inputs that allow data to be requested over a separated strobe input and a 3-bit data request code input. Any number of the 3 data request code lines can be linked in parallel as long as the source can drive the combined load of all inputs linked together (1.5K Ohm divided by the total number linked together). Data is transmitted over the serial lines using standard RS232 or RS422 characteristics. Strobe and data ground as reference:

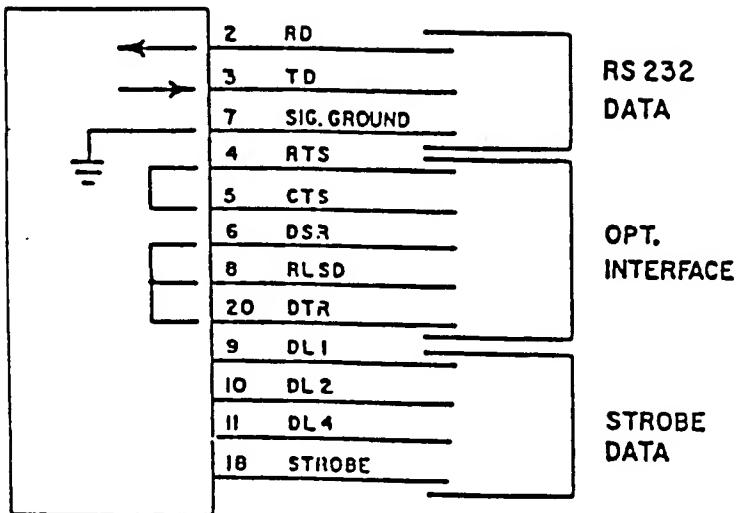
STROBE INPUT LEVELS

0 or low:	Open or 0 to VDC
1 or high:	3 to 30 VDC
Impedance:	1.5K Ohm

STROBE INPUT CODES (Octal Code)

0:	PA (Preset A request)
1:	PB (Preset B request)
2:	KC (K-Factor or counter request)
3:	KR (K-Factor of rate request)
4:	DC (Display of count request)
5:	DT (Display of grand total request)
6:	DR (Display of rate request)

WIRING HOOKUP
RS232/STROBE
(SUB-D 25 PIN CONN.)



23.11 STROBE INPUT WIRING

The unit RS232 option has a subminiature D25 pin female connector and is wired as a DCE (Data Communications Equipment) device. If it is connected to a DTE (Data Terminal Equipment) device, the interconnect cable should have wires 2 and 3 connected straight to the same pins on each end. If it is connected to another DCE device, Pins 2 and 3 must be crossed so that the wire to Pin 2 on one end goes to Pin 3 on the other end and Pin 3 on one end goes to Pin 2 on the other end.

23.11.1 RS232 WIRING

The unit requires only three wires for RS232 communication: Pin 7 (Signal Ground), Pin 2 (Receive Data), Pin 3 (Transmit Data). Pin 4 (Request to Send) are jumped internally to echo back the signals. Pins 6 (Data Set Ready), 8 (Received Line Signal Detector) and 20 (Data Terminal Ready) are also jumped internally to echo back any signal.

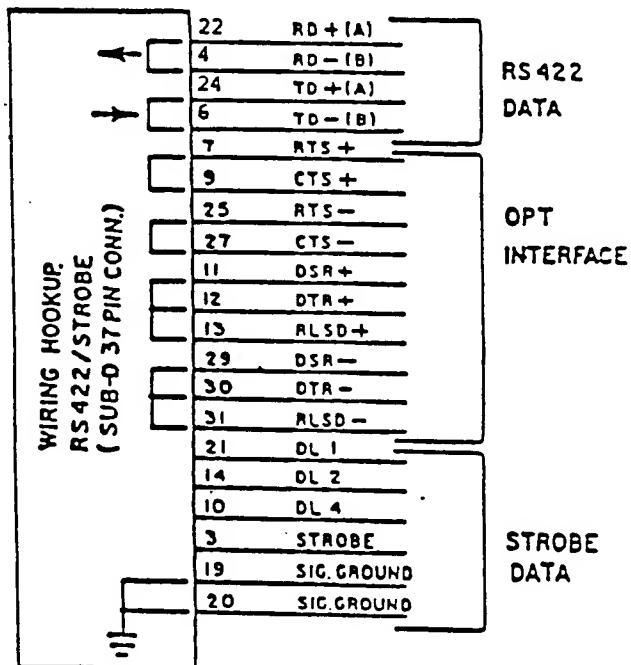
23.11.2 STROBE WIRING (OF RS232 25 PIN CONNECTOR)

The 3 data lines to generate the request code (DL 1: Pin 9, DL 2: Pin 10, 2: DL 4 Pin 11) must be set and remain constant while the positive

strobe of at least 25 milliseconds is given on the strobe input (Pin 18). Data is transmitted in RS232 serial format on Transmit Data Line (Pin 3).

23.12 RS422/STROBE INPUT WIRING

The unit RS422 option has a subminiature D 37 pin female connector and is wired as a DCE (Data Communication Equipment) device. It is designed to be connected to a DTE (Data Terminal Equipment) device. If it must be connected to a DCE device, it will be necessary to cross wires 4 and 6 as well as 22 and 24 at one end of the connector harness.



23.12.1 RS422 WIRING

Unit requires only 5 wires for RS422 communications; Pin 22 [Receive Data + (A)], Pin 4 [Receive Data - (B)], Pin 24 [Transmit Data + (A)], Pin 6 [Transmit Data - (B)], Pin 20 (Sig. Ground). The following groups of pins have been jumped internally to echo back the signals: (7, 9), (25, 27), (11, 12, 13), (29, 30, 31). Signal ground (Pins 19, 20) should be connected to provide a common reference.

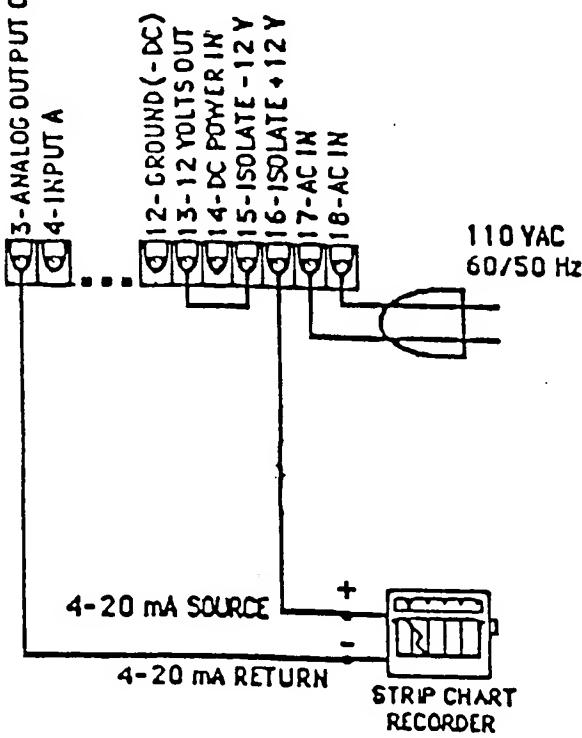
23.12.2 STROBE WIRING 111 OF RS422 37 PIN CONNECTOR

The 3 data lines to generate the request code (DL1: Pin 21, DL2: Pin 14, DL4: Pin10) must be set and remain constant while the positive strobe of at least 12 milliseconds is given on strobe input (Pin 3). Data is transmitted in RS422 serial format on Transmit Data Lines (Pin 6-24).

24 ANALOG OUTPUT

When used with digital input (3A or 3B), the Analog Output module is separate and plugs on to the right of the input module. When used with analog input (7A to 7E), the Analog Output logic is combined on one analog input/output module. (The white wire from the module plugs onto pin J2-6). The output on external pin 3 is a 4 mA to 20 mA output corresponding to the selected rate readings. A sinking driver generates a linear current across recorder, PLC, computer, external meter. In the program set up mode the user is prompted to "SET LOW" (4mA rate) and "SET HIGH" (20mA rate).

ANALOG OUTPUT



The unit can supply the 24VDC to power the current loop. (Connect Pin 15 to Pin 13. Pin 16 is now + 24VDC with respect to Pin 12). With Pin 15 connected to Pin 13, connect Pin 16 to the + DC side of the external device and connect Pin 3 to - DC side of the external device.

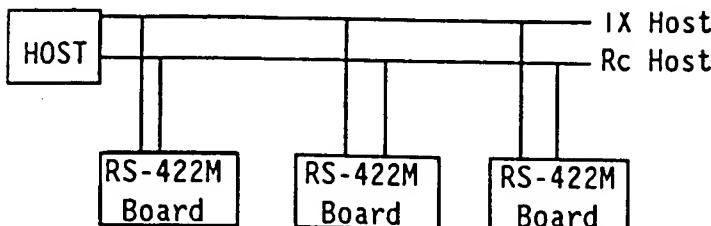
25 OPTIONAL -- RS-422M

25.1 GENERAL The unit RS-422M option is fully compatible with standard Opto Mux control modules. It can be connected into the bus with other control modules to give high speed counting/rate monitor and control. This document summarizes the operation of the RS-422M. It is recommended that you first read the Operating Instructions of the unit to become familiar with the format and methods used in setting up the basic instrument before using the RS-422M communication option.

25.2 INTRODUCTION RS-422M equipped units communicate with the host computer over an RS-422 communications link. The serial link is composed of four twisted pairs and a ground (9 wires) that connect to each RS-422M unit. It is possible to communicate with up to 256 individual units on a single serial link. This reduces wiring costs by eliminating the need for bringing large bundles of field wiring back to a central controller. The RS-422 link offers excellent noise immunity over long cable lengths.

25.3 COMMUNICATIONS RS-422M units can be configured to operate in multidrop or repeat mode via jumpers located on each RS-422M board. In a multidrop configuration, the last unit in the network can be up to 5000 feet from the host computer and up to 100 units can be connected without the need of repeater card. In this mode, if power is lost on one RS-422M unit, communication to that board are lost, but communications to the rest of the RS-422M boards on the link remain intact. A multidrop repeater card* can extend a communications link an additional 5000 feet with the addition of another 100 RS-422M boards. Longer distances can be covered by using multiple repeater cards.

Example of internal MULTIDROP operation:

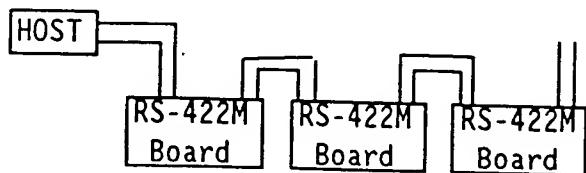


Repeater card available from:

OPTO-22
15461 Springdale Street
Huntington Beach, California 92649
Phone # 714-891-5861

In REPEAT MODE a total of 256 units may reside on a network. RS-422M units operating in this mode receive and re-transmit the data link signals. A power failure at a given RS-422M site will effectively "break" the link at that point. Units beyond the disabled unit will be unable to communicate with the host. RS-422M units operating in repeat mode may not reside on the same serial link as RS-422M units operating in multidrop mode.

Example of internal REPEAT mode operation:



25.4 DATA TRANSMISSION

Baud rate is the speed at which data is transmitted, expressed in bits per second. RS-422M supports 7 baud (300, 600, 1200, 2400, 4800, 9600, and 19.2k) which are automatically selected (AUTO-BAUDRATE) by the RS-422M board.

To insure secure data transmission, every RS-422M command message and every response includes a calculated checksum. RS-422M will not execute a command containing a checksum error.

25.5 SPECIFICATIONS

All Electrical specifications meet EIA RS-422M standards. (Refer to the units manual for a complete description).

25.6 SETTING UP THE UNIT

Under OUTCARD section of MENU, select the proper unit number. (Refer to Setting Address section of this manual). Press the enter button to continue to PL and SER. Select PL for RS-422M option and press enter button again. Once the unit is back in the Run mode, the RS-422M card will be activated.

25.7 SWITCH SETTINGS

Switch numbers 1-8 are located next to the terminal connections and are easily accessible. Switches 1-4 are for the selection of the proper group of addresses (see section on SETTING the ADDRESS). Dipswitches 5 and 6 are for the selection of the proper terminating resistors. Depending upon whether the unit is the last one on the network or whether Repeat or Multidrop mode is selected.

For Repeat mode switches 5 and 6 are always on. In Multidrop mode switches 5 and 6 are off, unless the unit is the last on the network. (In the multidrop mode, only the last unit on the network has switches 5 and 6 turned on).

NOTE: Switches 7 and 8 are not used.

25.8 MULTIDROP/REPEAT MODE JUMPER SETTINGS

The nine mode select jumpers are set at the factory prior to shipping. If the unit must be changed between Multidrop and Repeat mode, the case must be opened. Refer to Removing the Case section in the units manual. Locate the 9 jumpers on the top communications P.C. board and change to the mode desired per the following table.

	J1	J2	J3	J4	J5	J6	J7	J8	J9
MULTIDROP	X	X	X	X	0	0	0	0	X
REPEAT	0	0	0	0	X	X	X	X	0

25.9 SETTING ADDRESS

Each unit can be assigned a unit number from 0 to 15 through the front keypad in the OUTCARD setup mode. Switches 1 to 4 located next to the terminal, at the back, set the 0 to 15 "group number" for the unit. Use a combination of the switch settings and program to set a specific number for up to 256 units.

SAMPLE 1

Setting an address number of 45; Refer to Table 1, and see where 45 falls under address #. Set the switches corresponding to 45 (ie, 00X0). Then, thru the front keypad of the unit, in outcard section of menu under unit #, select #13.

SAMPLE 2

Setting an address number of 160; Refer to Table 1, and see where 160 falls under address #. Set the switches corresponding to 160 (ie, X0X0). Then, thru the front keypad of the unit, in the outcard section of menu, under unit #, select #0.

SAMPLE 3

Setting an address number of 248: Refer to Table 1, and see where 248 falls under address #. Set the switches corresponding to 248 (ie, XXXX). Then, thru the front keypad of the unit, in the outcard section of menu under unit #, select #8.

25.10 NUMBER/SWITCH TABLE

TABLE 1

*X=ON, 0=OFF

<u>ADDRESS NUMBER</u>	<u>SWITCH 4 3 2 1</u>	<u>UNIT #</u>
0	0 0 0 0	0
1	0 0 0 0	1
2	0 0 0 0	2
3	0 0 0 0	3
4	0 0 0 0	4
5	0 0 0 0	5
6	0 0 0 0	6
7	0 0 0 0	7
8	0 0 0 0	8
9	0 0 0 0	9
10	0 0 0 0	10
11	0 0 0 0	11
12	0 0 0 0	12
13	0 0 0 0	13
14	0 0 0 0	14
15	0 0 0 0	15
16	0 0 0 X	0
17	0 0 0 X	1
18	0 0 0 X	2
19	0 0 0 X	3
20	0 0 0 X	4
21	0 0 0 X	5
22	0 0 0 X	6
23	0 0 0 X	7
24	0 0 0 X	8
25	0 0 0 X	9
26	0 0 0 X	10
27	0 0 0 X	11
28	0 0 0 X	12
29	0 0 0 X	13
30	0 0 0 X	14
31	0 0 0 X	15
32	0 0 X 0	0
33	0 0 X 0	1
34	0 0 X 0	2
36	0 0 X 0	3
37	0 0 X 0	4
38	0 0 X 0	5
39	0 0 X 0	6
40	0 0 X 0	7
41	0 0 X 0	8

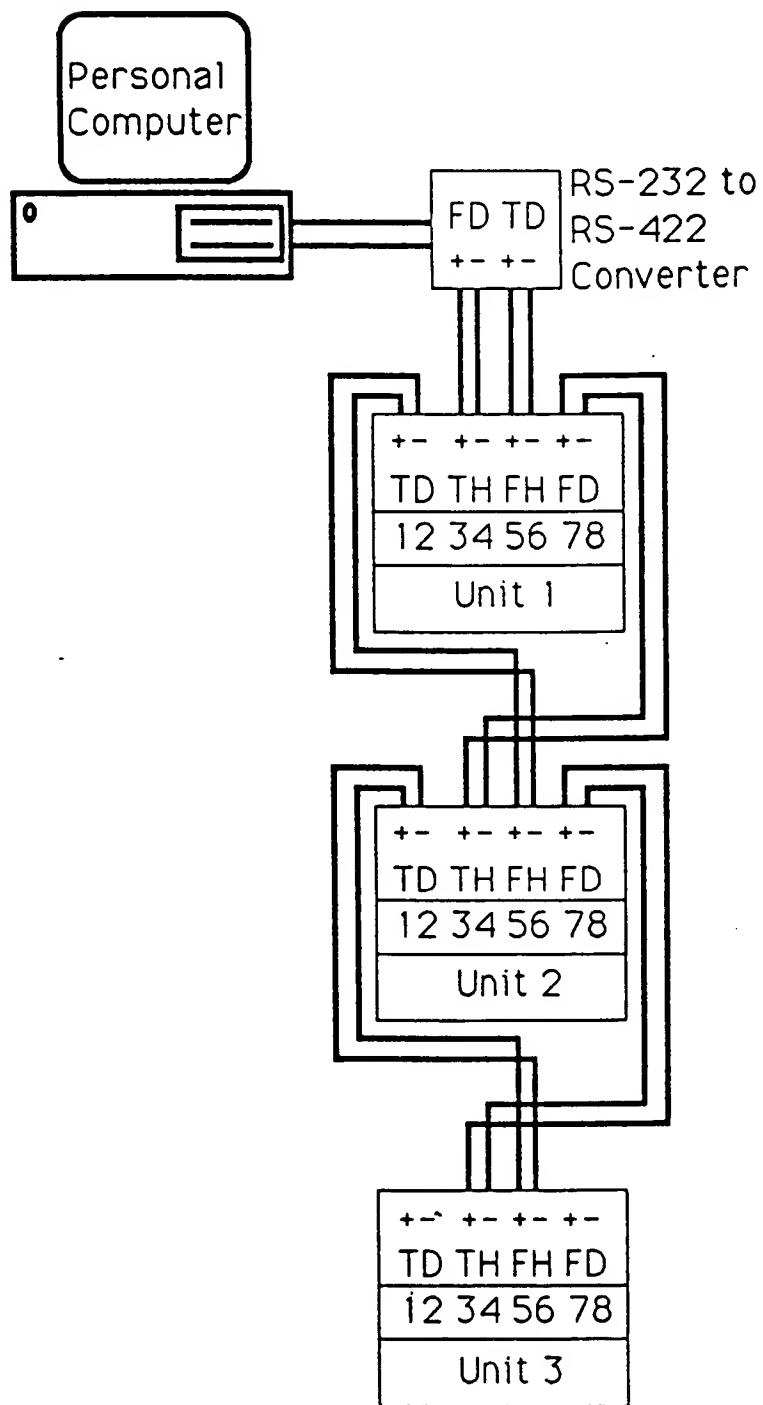
<u>ADDRESS NUMBER</u>	<u>SWITCH 4 3 2 1</u>	<u>UNIT #</u>	<u>ADDRESS NUMBER</u>	<u>SWITCH 4 3 2 1</u>	<u>UNIT #</u>
42	0 0 X 0	9	87	0 X 0 X	7
43	0 0 X 0	10	88	0 X 0 X	8
44	0 0 X 0	11	89	0 X 0 X	9
45	0 0 X 0	12	90	0 X 0 X	10
46	0 0 X 0	13	91	0 X 0 X	11
47	0 0 X 0	14	92	0 X 0 X	12
48	0 0 X 0	15	93	0 X 0 X	13
49	0 0 X X	0	94	0 X 0 X	14
50	0 0 X X	1	95	0 X 0 X	15
51	0 0 X X	2	96	0 X X 0	0
52	0 0 X X	3	97	0 X X 0	1
53	0 0 X X	4	98	0 X X 0	2
54	0 0 X X	5	99	0 X X 0	3
55	0 0 X X	6	100	0 X X 0	4
56	0 0 X X	7	101	0 X X 0	5
57	0 0 X X	8	102	0 X X 0	6
58	0 0 X X	9	103	0 X X 0	7
59	0 0 X X	10	104	0 X X 0	8
60	0 0 X X	11	105	0 X X 0	9
61	0 0 X X	12	106	0 X X 0	10
62	0 0 X X	13	107	0 X X 0	11
63	0 0 X X	14	108	0 X X 0	12
64	0 X 0 0	15	109	0 X X 0	13
65	0 X 0 0	0	110	0 X X 0	14
66	0 X 0 0	1	111	0 X X 0	15
67	0 X 0 0	2	112	0 X X X	0
68	0 X 0 0	3	113	0 X X X	1
69	0 X 0 0	4	114	0 X X X	2
70	0 X 0 0	5	115	0 X X X	3
71	0 X 0 0	6	116	0 X X X	4
72	0 X 0 0	7	117	0 X X X	5
73	0 X 0 0	8	118	0 X X X	6
74	0 X 0 0	9	119	0 X X X	7
75	0 X 0 0	10	120	0 X X X	8
76	0 X 0 0	11	121	0 X X X	9
77	0 X 0 0	12	122	0 X X X	10
78	0 X 0 0	13	123	0 X X X	11
79	0 X 0 0	14	124	0 X X X	12
80	0 X 0 0	15	125	0 X X X	13
81	0 X 0 X	0	126	0 X X X	14
82	0 X 0 X	1	127	0 X X X	15
83	0 X 0 X	2	128	X 0 0 0	0
84	0 X 0 X	3	129	X 0 0 0	1
85	0 X 0 X	4	130	X 0 0 0	2
86	0 X 0 X	5	131	X 0 0 0	3
	0 X 0 X	6			

<u>ADDRESS NUMBER</u>	<u>SWITCH 4 3 2 1</u>	<u>UNIT #</u>	<u>ADDRESS NUMBER</u>	<u>SWITCH 4 3 2 1</u>	<u>UNIT #</u>
132	X 0 0 0	4	177	X 0 X X	1
133	X 0 0 0	5	178	X 0 X X	2
134	X 0 0 0	6	179	X 0 X X	3
135	X 0 0 0	7	180	X 0 X X	4
136	X 0 0 0	8	181	X 0 X X	5
137	X 0 0 0	9	182	X 0 X X	6
138	X 0 0 0	10	183	X 0 X X	7
139	X 0 0 0	11	184	X 0 X X	8
140	X 0 0 0	13	185	X 0 X X	9
141	X 0 0 0	12	186	X 0 X X	10
142	X 0 0 0	14	187	X 0 X X	11
143	X 0 0 0	15	188	X 0 X X	12
144	X 0 0 X	0	189	X 0 X X	13
145	X 0 0 X	1	190	X 0 X X	14
146	X 0 0 X	2	191	X 0 X X	15
147	X 0 0 X	3	192	X X 0 0	0
148	X 0 0 X	4	193	X X 0 0	1
149	X 0 0 X	5	194	X X 0 0	2
150	X 0 0 X	6	195	X X 0 0	3
151	X 0 0 X	7	196	X X 0 0	4
152	X 0 0 X	8	197	X X 0 0	5
153	X 0 0 X	9	198	X X 0 0	6
154	X 0 0 X	10	199	X X 0 0	7
155	X 0 0 X	11	200	X X 0 0	8
156	X 0 0 X	12	201	X X 0 0	9
157	X 0 0 X	13	202	X X 0 0	10
158	X 0 0 X	14	203	X X 0 0	11
159	X 0 0 X	15	204	X X 0 0	12
160	X 0 X 0	0	205	X X 0 0	13
161	X 0 X 0	1	206	X X 0 0	14
162	X 0 X 0	2	207	X X 0 0	15
163	X 0 X 0	3	208	X X 0 X	0
164	X 0 X 0	4	209	X X 0 X	1
165	X 0 X 0	5	210	X X 0 X	2
166	X 0 X 0	6	211	X X 0 X	3
167	X 0 X 0	7	212	X X 0 X	4
168	X 0 X 0	8	213	X X 0 X	5
169	X 0 X 0	9	214	X X 0 X	6
170	X 0 X 0	10	215	X X 0 X	7
171	X 0 X 0	11	216	X X 0 X	8
172	X 0 X 0	12	217	X X 0 X	9
173	X 0 X 0	13	218	X X 0 X	10
174	X 0 X 0	14	219	X X 0 X	11
175	X 0 X 0	15	220	X X 0 X	12
176	X 0 X X	0	221	X X 0 X	13

<u>ADDRESS NUMBER</u>	<u>SWITCH 4 3 2 1</u>	<u>UNIT #</u>	<u>ADDRESS NUMBER</u>	<u>SWITCH 4 3 2 1</u>	<u>UNIT #</u>
222	X X 0 X	14	239	X X X 0	15
223	X X 0 X	15	240	X X X X	0
224	X X X 0	0	241	X X X X	1
225	X X X 0	1	242	X X X X	2
226	X X X 0	2	243	X X X X	3
227	X X X 0	3	244	X X X X	4
228	X X X 0	4	245	X X X X	5
229	X X X 0	5	246	X X X X	6
230	X X X 0	6	247	X X X X	7
231	X X X 0	7	248	X X X X	8
232	X X X 0	8	249	X X X X	9
233	X X X 0	9	250	X X X X	10
234	X X X 0	10	251	X X X X	11
235	X X X 0	11	252	X X X X	12
236	X X X 0	12	253	X X X X	13
237	X X X 0	13	254	X X X X	14
238	X X X 0	14	255	X X X X	15

SAMPLE WIRING DIAGRAM

SAMPLE WIRING DIAGRAM



26 OPTIONAL 16-POINT LINEARIZATION OF VARIABLE K-FACTOR FOR UNIT

26.1 DESCRIPTION

The 16 point K-Factor option is ordered by adding a "4" to the suffix of the part number. This feature allows the user to dial in from 3 to 16 different frequency points (inputs per second) and different K-Factor dividers from 0.00011 to 000000 for each of these frequencies.

The 16 point unit determines the incoming frequency and calculates a K-Factor line slope from the two closest data points that had been entered. The "specific K-Factor" is then proportionally interpolated using 8-position floating math. This K-Factor is applied to all inputs until the next frequency calculation, usually 1 second later. If a "0" frequency is entered into "point 1", the "point 1" K-Factor will be applied to all inputs received before the first frequency calculation.

The rate can be displayed in 3 ways: "SECONDS \downarrow ", "MINUTES \downarrow ", "HOURS \downarrow ", or "TEST \downarrow ". If "SECONDS" is selected, the unit displays the "base rate" calculated from the incoming frequency and the "specific K-Factor". If "MINUTES \downarrow " is selected, the rate displayed is 60 times the "base" rate. If "HOURS \downarrow " is selected, the rate displayed is 3600 times the base rate.

26.2 POINT DATA FORMATTING

In order to keep track of data, each Frequency/K-Factor data entry is assigned a point number. Any point number may be selected to view and/or change the Frequency/K-Factor data as long as the frequencies of the ascending frequencies. "BAD FREQ" will flash when exiting the set up mode if there is a sequence error. The unit will then display the sequence error point # so that corrections can be made.

NOTE A: Unit defaults "0" K-Factor to K-Factor of "1" since it is impossible to divide by "0".

NOTE B: "Point 01" will be the "low shut-off" frequency. Below this frequency no rate will be displayed nor count recorded. Point 01 should be assigned a frequency of "0" with a K-Factor for lowest flow especially if very slow flow is to be counted.

NOTE C: The entry of a frequency of "0" for "Point 03" or above will tell the unit to continue the K-Factor slope line calculated from the two previous Frequency/K-Factor points and ignore any higher point data. If a fixed K-Factor is desired, assign the same K-Factor to two ascending frequency points and enter a frequency of "0" in the next higher point entry.

NOTE D: K-Factors are always positive numbers. To avoid undesired K-Factors projected around "0" K-Factors, insure that a positive K-Factor is assigned for the highest used frequency.

NOTE E: The decimal in the "Total" and "Grand Total" is a dummy. The K-Factor should be calculated to show all numbers as if there were no decimal and then decimal added under DEC LOC section of DEV TYP MENU.

Note that the autoranging decimal in the rate (R) display will be shifted to the left as the "Dummy Decimal" is shifted to the left so that the rate display will be the same as the count. Example: A meter gives 33.4 pulses per gal. and it is desired to display in 1/10 gal. Move K-Factor decimal place to the left and key-in a decimal under DEC LOC MENU. K-Factor for gal. and 1/10 is 3.34 Rate will show 3.34 with decimal added while it would show 33.4 if no decimal were added.

26.3 TEST MODE

A special "TEST" mode can be selected to help set-up the points and K-Factors. If "TEST Y" is selected, the RATE ("R" display) will show the frequency (pulses per second) of the incoming signal. The TOTAL section will accumulate one count for each incoming pulse.

26.3.1 TEST MODE K-FACTOR CALCULATION

Calculate the K-Factors for flow meters with pulse or analog transmitters:

- A) Set the 16 point units to "TEST" and ENT point 00 to go to the run mode.
- B) At the lowest desired flow rate, rest the counter and let the unit count the incoming signal while the rate displayed is recorded.
- C) Interrupt the input signal when the known tested volume has gone through the flow meter. Switch to count display and read the number of counts that came in from the known volume as displayed on the unit. Divide the counts by the volume that past through the meter to determine the number of counts for 1 unit of measure, gallon, cubic foot, etc.
- D) Record this frequency and K-Factor for later entry into point 1 or point 2.
(See NOTE B above to determine if data should be entered in point 1 or 2).
- E) Assign ascending point numbers to correspondingly ascending frequencies when recording frequency/K-Factor data. A minimum of 3 points and a maximum of 16 points must be entered.

26.4 DATA ENTRY FOR 16-POINT

Press "D" until "16 POINT" appears on display. ENT.

Press D to step through options:

- SECONDS (Scaled rate per minute selected)
- MINUTES (Scaled rate per minute selected)
- HOURS (Scaled rate per minute selected)
- TEST (Test mode-rate per second with 1 count for each input (fixed K-Factor of 1) selected)

Press ENT when selected option is displayed.

Point 00 will appear on the display. ENT "POINT 00" to exit the set up and go to run mode or key in a point number from 1 to 16 and ENT.

"K" will flash with present K-Factor for that point. ENT or CLR and key on desired K-Factor.

Continue to step through the POINT numbers to view or change data. If a frequency of 0 is entered, in POINT 3 or above, the unit will ignore data above that point number. A K-Factor generated from the line slope of the 2 previous POINT entries will be applied to higher frequencies.

Exit "point set" routine by setting to POINT 00 and ENT. Unit will go to run mode. "BAD FREQ" will flash when exiting the set up mode if there is a sequence error. The unit will then display the sequence error point # so that corrections can be made.

If "TEST" is selected, point data can be entered into memory but when running, unit will add one count per each input (fixed K-Factor of "1") and display frequency (rate per second) of incoming signal. (See TEST MODE for more information).

**SETTING
16 POINT
K-FACTOR**

PRESS	DISPLAY
D	MENU FLASHES... TO DEV TYP↓
D	LOCKOUT↓
D	OUTCARD↓
D	ALG OUT↓
D	OUTFREQ↓
ENT	16 POINT↓
D	MINUTES↓
D	HOURS↓
D	TEST↓
D	SECONDS↓ (PRESS D TO GO TO MINUTES)
ENT (PRESS AS DESIRED)	POINT 00 (ENTER POINT 00 TO GO TO RUN MODE.)
1 (SELECT POINT 1)	POINT 01 (KEY IN POINT DESIRED)
ENT	F ** (SHOWS FREQUENCY IN MEMORY)
CLR	F 0
1 0 0	F 100 FREQUENCY SELECTED FOR POINT *)
ENT	K ** (SHOWS K-FACTOR IN MEMORY)
CLR	K 0
1 0 0	K 100 (K-FACTOR FOR POINT *)
ENT	POINT 02 (ENTER POINT DATA AS DESIRED)
CLR	POINT 00 (SELECT POINT 00 TO EXIT SET UP)
ENT	LAST TOTAL COUNT READING.

NOTE: If TEST↓ is entered, point data can be entered exactly as selected time entries. However, when unit "runs" in Test Mode "K-Factor" is always 1. "Rate"(R) displays frequency (Inputs per second). Counter displays 1 count per each input.

NOTE: "BAD SEQ" will appear if frequencies are not in ascending order with point numbers. After 2 seconds first point number with error will appear so data can be viewed and corrected.

16 POINT CURVE IS SET UP!

26.6 COMMUNICATION FOR 16 POINT

When 16-Point option is supplied with either RS232 or RS422 option, data can be read and changed as explained under Communication Section of the manual.

Codes to address 16-point data: (F=frequency; K=K-Factor; A to P = Point number 1 to 16)

FA = Frequency for A (Point 1)

KA = K-Factor for A (Point 1)

FB = Frequency for B (Point 2)

KB = K-Factor for B (Point 2)

-- = (Use of letters A to P for Points 1 to 16)

FP = Frequency for P (Point 16)

KP = K-Factor for P (Point 16)

CAUTION:

1) Frequency speed must increase with ascending point numbers. A bad sequence can be entered over the serial part. Unit will use calculated K-Factor based on first frequency match found, which may be wrong. Check by requesting a transmit of all frequency points used: FA FB FC FD to F_ to insure ascending sequence is entered or enter "POINT 00" on front keypad and unit displays "BAD SEQ" if there are errors.

2) After device is activated, there must be a delay to allow "Device #--" to be transmitted by the device before new commands are sent to the unit.

To request a transmit of data, send a code for information desired. To change data, send the desired address code followed by a space and the new number desired.

Sample Code request and response:

TRANSMIT FROM TERMINAL

(S) = Space

Example A:

D13(S) (unit #13 activated)

FA(S)0(S)KA(S)123 (ENTER)

(Frequency for A (Point 1) is set

to 0, K-Factor for A (Point 1)

is set to 123)

RECEIVE FORM THE UNIT

Device #13

FA 0 KA 123

(Unit echoes back

command as sent).

Example B:

D11(S) (unit #11 is activated)

FC(S)500(S)KC(S)305(S)

FC(S)KC(S)(ENTER)

(Frequency for C (Point 3) is set

to 500, K-Factor for C (Point 3)

is set to 305,

Frequency of C (Point 3) is

sent, K-Factor of C (Point 3)

is sent.

Device #11

FC 500 KC 305

FC KC

Unit echoes

back commands as sent).

500

305

(Unit transmits frequency and
K-Factor data for C (Point 3).

26.7 IRREGULAR SHAPE VESSEL APPLICATION NOTE: MEASURE VOLUME IN IRREGULAR SHAPED VESSELS WITH NEW 16-POINT LINEARIZATION OPTION IN THE UNIT

In the past it was difficult to calculate the volume of liquid and set up the equation or computer model to display the volume in containers with odd shapes. It usually required that a special electronic memory be made for each container.

The "16-Point" option allows a simple way to program the unit to display correct volume with resolution to 10,000 parts.

all that is needed is the analog signal from a weight or level transducer (4 to 20 or 0 to 20mA, 0 to 5, 1 to 5, 0 to 10 VDC).

The easiest way to set the 16 points is to use the "Test" mode while filling the vessel. In this "Test" mode the unit converts the analog signal to a 1 to 10,000 base frequency reading.

Record the "Test" frequency reading in a column next to actual amount put into the vessel. Choose 16 points where there is a significant ratio change between the frequency reading and the actual volume. Divide the "Test" frequency by the actual volume to determine the point K-Factor to be entered with the "test" frequency. Simply key in these point frequencies and K-Factors in order of ascending frequencies. Volumes between the 16 points entered will be interpolated from a K-Factor line slope generated from the closest 2 points entered.

Once the "16-Point" frequencies and K-Factors are entered, set the unit to "Second" reading of rate to display actual volume in the vessel. Disregard the counter readings.

Two separate control relays can be set to activate at different volume for monitoring or dispensing applications.

An optional 4 to 20mA output of the corrected

volume can be supplied to drive a strip chart recorder, remote meter or other equipment.

27 CONCLUSION

This manual has attempted to cover all aspects of operation of the unit. It is written to cover most anticipated problems and misunderstandings. If some questions still arise or you feel some improvements can be made to this manual, please feel free to contact your local representative.

We hope you will be pleased with our product. If you have any questions concerning our warranty, repair, modification or returned goods process, please contact your local distributor.

28 WARRANTY

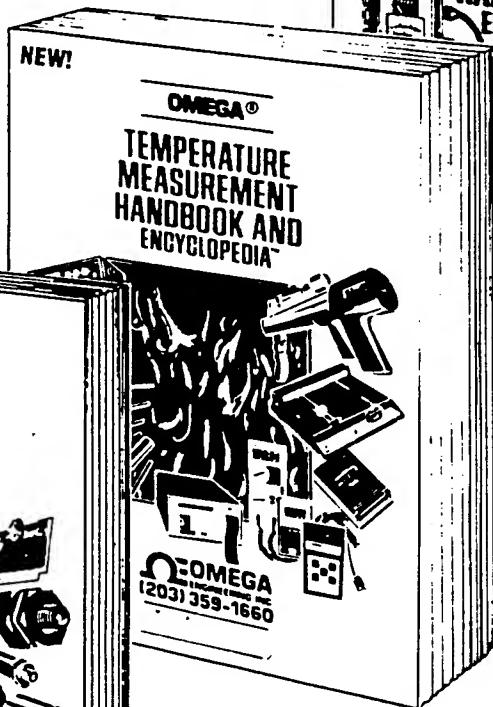
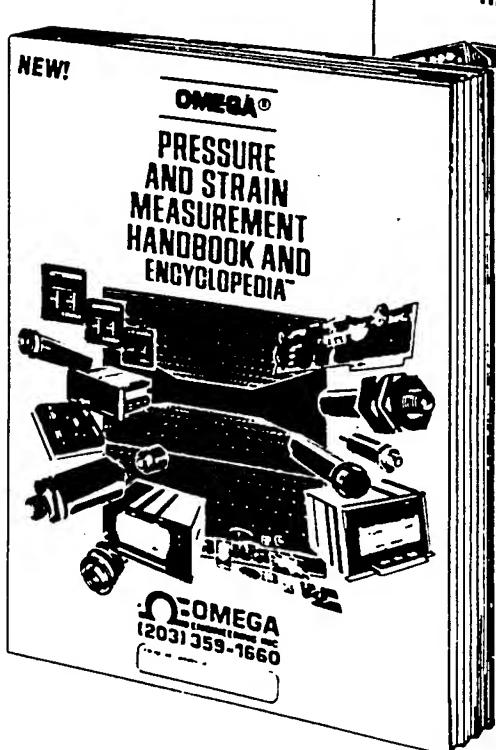
This product is warrantied against defects in materials and workmanship for a period of two (2) years from the date of shipment to buyer.

The warranty is limited to repair or replacement of the defective unit at the option of the manufacturer. This warranty is void if the product has been altered, misused, dismantled, or otherwise abused.

All other warranties, expressed or implied, are excluded, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

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